1/PRT



## Description

### Coating Installation

The invention relates to a coating installation with a vacuum chamber comprising a suction port and a gas feed, in which a sputtering cathode and a substrate holder are housed and in which the vacuum chamber is divided into a cathode chamber and a substrate chamber by a screen disposed between the sputtering cathode and the substrate holder.

A coating installation of the above type is the object of EP 0 795 623. In the coating installation shown in this publication, process gas, consisting of argon and oxygen, flows near the substrate into the substrate chamber and is drawn off above the screen via a suction port on the cathode chamber. In the cathode chamber a metering device implemented as a lambda probe serves for the purpose of monitoring the oxygen content in the cathode chamber and controlling the power of the sputtering cathode according to the oxygen content. Through the common feed of the reactive gas and the process gas and through the drawing off of the gas via a suction port on the cathode chamber it cannot be avoided that the target of the sputtering cathode is exposed to a considerable oxygen concentration. Due to this, an undesired oxidation of the target occurs, whereby a low oxidic oxidation rate results instead of a desired high metallic oxidation rate. The screen according to EP 0 795 623 has the concept of preventing a reduction of the layer quality due to oblique coating.

The problem underlying the invention is to design a coating installation of the type stated initially so that a reactive gas concentration is possible that is sufficiently high to enable a complete reaction of the developing layer without, due to this, the target surface at the same time reacting with the reactive gas in an undesired manner and, as a consequence, a reduction in the capacity of the coating installation occurring.

This problem is solved according to the invention by the fact that the cathode chamber as well as the substrate chamber comprise a direct suction port and each comprises its own gas feed and that the gas feed into the cathode chamber is connected to a process gas source and the gas feed into the substrate chamber is connected to a reactive gas source.

Due to this design of the coating installation, essentially independent gas streams in the cathode chamber and the substrate chamber result. The reactive gas is, according to the invention, shielded from the sputtering cathode by the screen. Thereby only insignificant amounts of the reactive gas, as a rule oxygen, get into the cathode chamber so that no reaction of the target surface, and thus a reduction of the coating capacity of the coating installation, results. The flow of the particles stemming from the target surface and forming the layer reaches the substrate through the aperture in the screen. Thanks to the forming according to the invention of two separate gas streams in the vacuum chamber the aperture in the screen can be large so that the particles stemming from the target surface encounter little hindrance on their way to the substrate without, conversely, an undesirable amount of oxygen reaching the sputtering cathode and oxidation occurring there. It has been shown that the shielding effect of the screen for the sputtered particles can be overcompensated by the possible rate increase at the target due to the low percentage of reactive gas there. Particularly clear increases of the specific coating capacity resulted with the coating installation according to the invention in the generation of transparent SnO and ZnO layers with reactively driven DC sputtering cathodes.

A particularly good separation of the gas streams results when each of the cathode chamber and the substrate chamber is connected to its own vacuum pump stand.

Disposing the gas feed and the suction port on opposite sides of both the cathode chamber and the substrate chamber contributes to the additional separation of the two gas streams.

Disposing an anode between the sputtering cathode and the substrate in the vacuum chamber contributes to the further improvement of the layer quality.

The effect of the plasma glow on the layer growth is inhibited as little as possible if, according to another extension of the invention, the anode is disposed, covered by the screen, in the substrate chamber between the screen and the substrate holder. Such an anode causes the plasma glow to extend through the screen aperture over the point of coating of the substrate in the direction of the slot sluice. Thereby the layer properties can be improved. In particular, a high layer thickness can be achieved by such an anode arrangement. Since the anode is covered by the screen, no noteworthy coating of the anode occurs.

The anode can be formed in the customary manner. It is particularly advantageous if the anode is formed by two heated tubes. Since SnO and ZnO have a relatively high conductivity, the coating of the anode necessarily occurring during the coating process of the substrate, and loss of effect appearing with this, play no role in such coating materials. Setting the anode, encircled with a weak magnetic field, by pulses to negative potential can, however, also be provided in order to keep it conductive and clean.

It is, however, also possible to provide that the anode simultaneously forms the screen.

It serves the further increase of capacity of the coating installation if the cathode is a double magnetron cathode.

The target is coated as uniformly as possible and thus has as long a service lifetime as possible if, according to another extension of the invention, the cathode is a rotating cathode.

Oxidic, and thus low, erosion rates of the target can be reliably avoided if, according to another extension of the invention, a metering device for reactive gas is disposed in the cathode chamber and the coating installation comprises an element regulating, as a function of the concentration of the reactive gas in the cathode chamber, the power of the sputtering cathode.

It has turned out to be particularly advantageous if the ratio of the screen's aperture length, measured in the direction of transport of the substrate, to the sputtering cathode's width, measured in the direction of transport of the substrate, is less than 0.75, preferably 0.5 to 0.3.

The invention allows different forms of embodiment. For additional illustration of its basic principle one of these is represented schematically in the drawing and is described in the following.

The drawing shows in section a coating installation according to the invention. This has a vacuum chamber 1 which is subdivided by a screen 2 into a cathode chamber 3 and a substrate chamber 4. In the cathode chamber 3 a sputtering cathode 5 is located which is electrically insulated with respect to the vacuum chamber 1, said sputtering cathode being formed in the case of this embodiment example as a magnetron cathode and comprising on the side of the screen 2 a target 6. Below the screen 2, and covered by it, an anode 7 is disposed in the substrate chamber 4. Seen in the drawing on the left side of the cathode chamber 3, a gas feed 8 is located which is connected to a process gas source 9. A suction port 10 with a vacuum pump stand 11 is disposed on the opposite side of the cathode chamber 3.

In the substrate chamber 4 there is a substrate holder 12 with a substrate 13 to be coated. The ratio of the screen 2's aperture length, measured in the direction of transport of the substrate 13, to sputtering cathode 5's width, measured in the direction of transport of the

substrate 13, is less than 0.75, preferably 0.5 to 0.3. Just like the cathode chamber 3, the substrate chamber 4 has, on the same side as the cathode chamber 3, a gas feed 14, which is connected to a reactive gas source 15. Furthermore, port 16 with a vacuum pump stand 17 is provided opposite to the gas feed 14.

To regulate the coating process, there is, in the cathode chamber 3, a metering device 18 formed as a lambda probe and comprising a probe-heating element 20, which has a connection to a power regulator 19 of the sputtering cathode 5. Thereby the concentration of the reactive gas in the cathode chamber 3, as a rule the oxygen concentration, is measured and, according to said concentration, the voltage of the sputtering cathode 5 regulated.

List of Reference Numbers

1 Vacuum chamber
2 Screen
3 Cathode chamber
4 Substrate chamber
5 Sputtering cathode

6 Target
7 Anode
8 Gas feed
9 Process gas source
10 Suction port

11 Vacuum pump stand
12 Substrate holder
13 Substrate
14 Gas feed
15 Reactive gas source

16 Suction port
17 Vacuum pump stand
18 Metering device
19 Power regulating element
20 Probe heater